

DRAFT

1981 - Annual Report  
Primary Processes R & D - Tucson

A. Staff

At year end, total staff numbered 14. The results of the recruiting effort to date have been very satisfactory. The core group comes from diverse backgrounds and has an impressive array of applicable skills. The group holds 50+ patents.

	<u># Exempt</u>	<u># Non-Exempt</u>
Plan (12/31/81)	13	5
Actual (12/31/81)	10	4
Transfer from AAC	2	0
Transfer from ACC	2	1
External Recruiting	6	3
Advanced Degrees	7	NA

B. Facilities

Availability of laboratory facilities were at a premium in 1981. Construction of a new geo-analytical laboratory by Anaconda Minerals in 1982 should alleviate this situation and make two more research labs available.

During 1981, a large lab and storage area was refurbished for our usage and access to the back-half of the new Fire Assay lab provided a temporary facility for small-scale reduction work.

Specification and design of a 10,500 square foot permanent facility for Carbon research and small-scale (up to 2000 ampere) reduction cell work was completed and an AFE approved. Construction started early in January. The facility should be fully operational for September 1982.

A large open-area office in the West Wing was converted into 4 offices and a secretarial/reception area for the group.

C. Technical Program Progress

1. 10101 Anaconda Clay Process

1981 Budget

1982 Budget 40M

1981 Objective Conduct comprehensive technical review of process for Basic Resources management.

1981 Progress

A technical review (Report No. 81-2) of the Anaconda Alumina-From-Clay process was completed. This updated all process information and was used at the basis of an AFE requesting an engineering design study. As the process is apparently only just competitive with Bayer, an investigation of possible modifications to improve process economics was undertaken. Laboratory studies to investigate the feasibility of replacing the second crystallization for product purity (85MM capital) with a simple acid leach of product from a single crystallization were begun. Also, an investigation was undertaken to possibly replace the clay calcination step with a fluoride-ion activation step to reduce energy consumption by 10%.

1982 Program

Complete experimental programs and evaluate the impurity leach process and F-ion activation process modifications.

2. 10104 AD-105 Process

1981 Budget

1982 Budget 135M

1981 Objective Evaluate basic process postulates on a bench scale.

1981 Progress

Bench scale experimentation established that alumina could be made via the proposed synthetic ammonoalunite intermediate. Effects of ammonia concentration, temperature and time on the precipitation of ammonoalunite were determined for synthetic mixtures. These results were outlined in Report 81-19 and established the practicality of these process steps. Preliminary work on the thermal decomposition of ammonoalunite to alumina was carried out. A preliminary material and energy balance (based on limited data) compares favorably to the Bayer process.

Based on the Record of Invention (R. W. Bartlett and T. R. Bolles) and subsequent studies, patent application procedures were initiated.

#### 1982 Program

Continue experimental work on the clay leaching and hydrolysis step. Focus on identifying the resulting components of the thermal decomposition step, as the overall process viability depends on being able to recover the ammonia and sulfuric acid for process recycle streams. Assess the commercial potential of the process based on experimental results.

### 3. 10103 Potlining Reclamation Process

#### 1981 Budget

1982 Budget 135M

1981 Objective Review potentially available technologies and identify processes for further consideration to economically recover F-values from potlining.

#### 1981 Progress

A literature search was conducted to identify potentially available technologies for the disposal of and/or resource recovery from spent potlining. After reviewing the literature, a process flowsheet was developed which proposes to incinerate carbon, recover fluoride values, and treat all plant effluents for environmental acceptability. A record of invention was submitted to the legal office in Denver. Laboratory investigations into the process chemistry were begun.

A study of the Alcan-D process for resource recovery showed that the process, as presented in the literature, could not stand alone because of two plant effluent streams containing high amounts of sulfur dioxide or hydrogen fluoride. A modification to the Alcan flowsheet was made which allowed for fluoride recovery via a wet method-aluminum fluoride production system. In addition, an oleum plant was included for sulfur recycle. A record of invention was submitted to the Denver legal office.

An Anaconda-Alcan joint potlining disposal/recovery study team was formed which reviewed the known potentially available treatment technologies. The joint study group concluded and recommended that the Anaconda-S, the Mini-L, and the Alcan-D processes for spent lining resource recovery be further investigated on an economic basis.

1982 Program

Carry out capital and operating cost estimates for an economic evaluation of the Alcan Mini-L and -D processes and the Anaconda process. Based on recommendations of the joint-study team, formulate and initiate a specific development program.

4. 20802  $\text{AlCl}_3$  Process

1981 Budget

1982 Budget 100M

1981 Objective Investigate feasibility of making anhydrous  $\text{AlCl}_3$  from aluminum chloride hexahydrate.

1981 Progress

Based on a Commonwealth Scientific and Industrial Research Organization (CSIRO) patent, work was initiated on chlorination of the clay process aluminum chloride hexahydrate to anhydrous aluminum chloride. Partial calcination of ACH to 500-600°C provides a very reactive material for chlorination with a carbon reductant. Experiments with various forms of the reductant such as CO and green, partially and fully calcined petroleum cokes have been carried out.

Results are extremely encouraging and indicate the possibility of a chlorination process based on clay feedstock which is technically and economically superior to the Alcoa process. On a lab scale, chlorination rates of about 7 to 9 times greater than the Alcoa process have been achieved. A 350°C lower operating temperature should greatly simplify materials of construction requirements and the lack of sodium in the feedstock eliminates separation and build-up processing problems experienced using Bayer alumina.

1982 Program

Continue lab experimentation to identify the most preferred reductant. Determine processing conditions which do not result in PCB formation at the lower temperature. Design and 8"-12" reactor for initial scale-up and more precise formulation of material and energy balances.

5. 20803 Lithium Fluoride Electrolyte

1981 Budget

1982 Budget 50M

1981 Objective Provide technical support to plant operations tests of lithium modified bath.

#### 1981 Progress

Assisted Sebree in developing a method for chemical analysis of Li bath. A comprehensive literature search was initiated and plans made to prepare a "position" paper related to conventional lithium usage. A conductivity bridge has been obtained and a melting set-up is being constructed to allow specific properties determinations for modified electrolytes.

#### 1982 Program

Develop bath liquidus diagram and alumina solubility for the likely range of lithium concentrations. Determine properties of more drastically modified (i.e. lower temperature) electrolytes.

### 6. 20804 Pot Magnetics

#### 1981 Budget

1982 Budget 175M

1981 Objective Develop a means of magnetic compensation for Columbia Falls cells to improve cell stability, decrease power consumption and increase current efficiency.

#### 1981 Progress

In conjunction with Columbia Falls, a contract was negotiated with ASV to recommend bus-bar modifications that would improve the magnetic field configuration based on mathematical modelling. ASV's report recommended a standard, fully asymmetric 6/7, 13/0 modification which is predicted to reduce vertical magnetic field asymmetry to reasonable levels. Engineering design studies at Columbia Falls indicate the proposed modification can be reasonably field retrofitted.

Expected benefits are an increase of 0.5-0.75% current efficiency, a 150 millivolt reduction in pot voltage and an inventory reduction of 5000 pounds in the metal pad.

#### 1982 Program

Retrofit and test at least 10 pots and evaluate results. Construct a magnetic field measuring probe to assist in evaluation.

7. 20808 Petroleum Pitch

1981 Budget

1982 Budget 80M

1981 Objective Investigate technical feasibility of replacing coal-tar pitch binder with petroleum pitch.

1981 Progress

A preliminary technical assessment of the only commercially available petroleum pitch, Ashland 240, indicates that it does not have the binder quality of coal-tar pitch. The resulting baked carbon is mechanically weaker and less dense with higher resistivity and porosity which will result in poorer anode performance. It is likely that it would give acceptable performance in prebake operations but lead to problems with Soderberg dry anodes.

1982 Program

Optimize the formulation of A-240 pitched composites and upgrade the quality by addition of quinolin insoluble materials and/or other cross-linking agents.

8. 20809 AD-108 Composite Anode Process

1981 Budget

1982 Budget 280M

1981 Objective Demonstrate the technical viability of the composite anode process on a lab scale.

1981 Progress

Temporary facilities were designed and assembled to allow operation of a 100 ampere cell. A 150 ton press was obtained and installed. Molds for forming 3" diameter prebaked anodes were made. A baking furnace and atmosphere box were constructed for anode baking. Battery chargers were purchased and modified to supply d.c. power.

Initial experimental runs with a prebaked anode demonstrated the basic process concept that Hall cell chemistry could be effected without chemical solubility of alumina in the electrolyte at approximately 4 kwh/lb and 90% current efficiency.

Prebaked anodes have been made using dried aluminum trihydrate, partially calcined aluminum trihydrate and metallurgical grade alumina and performed satisfactorily in electrolysis runs. Work has also been initiated using discrete particle anodes.

This process could provide a retrofit means for existing Hall cells with a power consumption of 4 kwh/lb and 90+% current efficiency. Five records of invention have been submitted.

1982 Program

As the form of the anode will likely determine the ultimate commercial potential of this process, work will focus on identifying the most promising anode configuration for a commercial operation. Scale-up design to 2000 amperes is planned for the latter part of the year.